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THE ARID REGIONS OF THE UNITED STATES

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JUN 9 1916

Our honored President in his opening address on "the relations of the currents of air and water to animal and vegetal life and to the temperature of countries" gave an admirable description of the interdependence of climatic forces and showed in a concise manner how the topography of a country modifies the character of life, and through this fixes the industrial and social relations of its inhabitants. His address renders it unnecessary to discuss the causes of aridity, or to more than mention the general effects; so this paper, supplementing what has been said, will dwell more upon the industrial or economic side of the matter, describing in general terms the present utilization of this vast region, much of it consisting of vacant lands.

To the people of many countries, as well as our own, the geography of the arid regions of the United States has a peculiar interest, owing to the fact that they include by far the greater part of the public lands, upon which new homes can be freely made either by our citizens or by foreigners intending to become citizens. These regions may be described in a general way as being in the western half of the United States, beyond the great plains, and extending westward nearly to the Pacific coast. On the north and south they are bounded by territorial lines, the conditions of aridity prevailing in the north through Canada nearly or quite to the Arctic circle, and south through Mexico until interrupted by the belt of tropical rains. Although characterized by prevailing or occasional droughts, these areas are by no means a continuous desert. On the contrary, the deserts, as the term is applied in the old world, are comparatively rare and relatively small in extent.

The arid regions may be defined as those portions of the United States where the rainfall, in quantity or distribution, is not favorable for the production of the ordinary cultivated food products.

The limits are not easy to place, for they depend upon climatic forces which vary in intensity from year to year—that is to say, in any given locality within the arid regions there may not be for several successive years sufficient moisture for maturing crops of grain, while in the following year rain occurring at the right time may enable a farmer to produce a heavy crop. Thus in the latter year these arid regions might be considered as reduced in size, to be again increased as drought follows drought. It is necessary, therefore, to assume certain arbitrary boundaries based upon considerations of general success or failure of ordinary agricultural operations in so far as they are dependent upon rainfall.

For the eastern boundary it is convenient to assume the one hundredth meridian west of Greenwich, although, as a matter of fact, "dry" farming has been successfully carried on as far west as the one hundred and fifth meridian or even beyond. The western boundary is more irregular, owing to a wide difference in the topography of the country which lies between the well-defined arid and humid areas near the Pacific coast.

As laid down by Powell* on the maps of the Geological Survey, the southwestern boundary of the arid region is the Pacific ocean up to a point on the coast of California north of Monterey bay. From here the line turns inward across the valley of the San Joaquin, then, excluding the bay counties, follows northward along the western foothills of the Sierra Nevadas and the eastern slopes of the Cascade range of Oregon and Washington, in which latter state it turns eastward, excluding from the arid regions the northeastern portions of Washington and Idaho. These lines, as originally drawn, were based largely upon the assumption that twenty inches of annual rainfall were necessary for farming operations, but were modified, however, by considerations of the seasonal distribution.† The lines thus laid down, although they may be criticised from various standpoints, are sufficiently exact for any general discussion, and are, perhaps, more useful than others drawn with greater nicety and attempting to reach higher precision.

* J. W. Powell: Second annual report of the irrigation survey, in Eleventh Annual Report of the United States Geological Survey, part 2, irrigation, Washington, 1891.

† Lands of the Arid Regions of the United States, J. W. Powell, Washington, 1879, p. 3 et seq.

Within this great area, the extent of which is nearly half that of the United States, there is almost every variety of topography and climate, from the low sandy plains exposed to almost tropical heat to the lofty mountain ranges with alpine snows and winds. Portions of it are as truly humid as any part of the east, but these are too small and isolated to be severally distinguished in a broad survey of the whole. Plant life is everywhere abundant, but it is of a kind strange to the eyes of the traveller from the Eastern states, appearing to him sparsely distributed and partaking of the general dry sun-burned character of the landscape. The bright green of fields and trees is rarely seen in the natural conditions, except after the rainy season, or on the high, well-watered mountain slopes. During the long seasons of drought the vegetation becomes brown and dusty, apparently dying, to revive, however, after the occasional rains.

During the many years in which the population was spreading from the Atlantic coast westerly over the broad Mississippi valley the arid regions were regarded as of little or no value, and were left for the Indians, the wandering trapper or prospector, and the despised Mormon; but when at last the fertile areas of the east were exhausted and places for homes must be had elsewhere, the people of the eastern part of the United States suddenly awoke to the realization that there were great resources yet to be developed within this vast extent of country. Thus within comparatively few years the population of the arid region has enormously increased. Every possible resource is being rapidly exploited, and the results of geographers and other investigators are being immediately acted upon to aid in pushing forward the development of this new land, which from its enormous extent promises to furnish homes for future millions.

The arid regions, as a whole, are best known by their mineral wealth, especially of the precious metals. For many years mining has been the principal industry, the necessary supplies being originally brought from great distances. Agriculture was then deemed not only as too slow a road to wealth, but it was even asserted that owing to drought it would be utterly impracticable. Stock-raising, however, gradually encroached upon the areas hitherto regarded as deserts, the cattle men, as they were forced westward by the advance of civilization, gradually displacing the roving bands of Indians and buffaloes. A peculiar form of agriculture, looked down upon by the adventurous miners and

cattle men, had long been practiced by the Pueblo Indians and neighboring Mexicans, and to a certain extent adopted by Mormons when driven into the wilderness by their fellow-Christians. This depended upon the cultivation of the soil by artificial application of water, obtained usually from a small river or creek, and conducted to the field by laboriously-made ditches, often miles in length. The expense and trouble of applying water necessitated the tillage of relatively small farms, this disadvantage being compensated in part by a larger average production. Nothing could be in greater contrast to the broad corn fields of the Mississippi valley, extending on all sides to the horizon, than the miniature gardens, from which, however, come luscious fruits and extraordinary vegetables.

As mines were opened and towns established it soon became evident that in the long run the furnishing of food-stuffs and forage would be equally profitable with laboring in the mines and mills, if not more so. The methods of the Mormons and Mexicans were copied, new sources of water-supply sought, ditches dug, and land brought under cultivation wherever it could be irrigated. Thus it has resulted that within a few years towns have sprung up in every direction, most of them dependent to a large extent upon mining, but having, through practice of agriculture by irrigation, capabilities of self-support and of future extension. These areas are so vast that the land irrigated or occupied by towns and mines or other industries forms but a very small percentage of the total area, most of which still belongs to the United States and is open to entry and settlement under the homestead laws.

The total land area west of the 100th meridian and excluding certain of the more humid portions of Oregon and Washington is 1,371,960 square miles,* or, in round numbers, 878,000,000 acres. Of this, about 7 per cent, or 64,000,000 acres, may be considered as desert, having no known value, even in its minerals. A somewhat larger area—about 9 per cent, or 83,200,000 acres—is timbered, this heavily wooded land consisting mainly of mountain slopes and plateaus. Fringing this and scattered on the hill slopes and along the streams are clumps of trees capable of yielding firewood, fence posts, etc. The aggregate area of these scantily wooded lands is estimated to be 115,200,000 acres, or a

*Thirteenth annual report of the United States Geological Survey, part 3, p. 8.

little less than 13 per cent of the total. Deducting the aggregate acreage of desert and wooded lands, there are left about 615,600,000 acres, the greater part of which supports a scanty herbage which, either green or sun-cured, is readily eaten by cattle. This may all be grouped under the head of grazing lands, since at one time or another of the year herds of cattle or sheep can find sustenance. Most of this latter class of land, comprising over two-thirds of the area west of the 100th meridian, has a fertile soil and climate favorable to agriculture in all respects save that of moisture. With water, great crops could be produced, but without it nothing but the scanty native grasses succeed. The area which has actually been redeemed by irrigation is quite small, not to exceed 1 per cent. The eleventh census of the United States found that in 1889 only 3,631,381 acres* were irrigated, this being but four-tenths of 1 per cent of the entire area west of the 100th meridian. Besides the area irrigated a relatively small area was cultivated by "dry" farming, the yield being, however, small.

The further extension of agriculture within the arid region rests on the complete utilization of the water supply. As previously stated, the streams have been employed to a large extent and there now remain only a few rivers from which water for irrigation is not diverted.† These flow on undisturbed because of the great expense, and the engineering difficulties encountered rendering doubtful the financial success of any undertaking. In the case of many of the smaller streams the aggregate of the claims to the water exceed by far the ordinary quantity discharged, and, as a result, most of the claimants must be satisfied with an amount of water less than that to which they assert ownership. At the same time a large proportion of the water of these streams flows to waste either in floods or in winter, all of which could be used to advantage if it could be held by storage.‡ The enormous cost of creating reservoirs for the waste waters and the small apparent profits have to a large extent deterred private capital from entering upon such projects.

* Eleventh Census of the United States, 1890, *Irrigation in Western United States* by F. H. Newell, p. 3.

† *Water Supply for Irrigation* by F. H. Newell, in thirteenth annual report of the United States Geological Survey.

‡ *Hydrography of the Arid Regions* by F. H. Newell, in twelfth annual report of the United States Geological Survey, p. 224 et seq.

The tillable lands to be benefited by water conservation or by the utilization of the larger streams not now diverted by canals are almost wholly owned or claimed by individuals or corporations, so that future developments must rest most largely with these. Wise legislation will do much to aid in making feasible many great undertakings, but as a rule it may be said that developments in this line must depend largely upon individual efforts and upon the ordinary laws of supply and demand.

It has been estimated that by a complete utilization of the water supply of the arid regions about 40,000,000 acres can be irrigated; but, allowing even that 100,000,000 acres of the fertile grazing land can be thus redeemed, there still remain over 500,000,000 acres, most of which, as well as the desert and timber acres, are still in the hands of the general Government.

The question as to the best utilization of the great body of unoccupied lands is one of immediate concern to the country at large, as well as to the inhabitants of this area. In a general way it may be said that the more easily available resources have already been taken possession of by individuals or by associations of men, and there remain only such as were rejected or not available. Much of the best mineral land is owned by private parties, but even on the explored Government land there are probably many mines yet to be discovered. The herds of cattle have increased to such an extent that the lands, whether owned by the Government or by corporations, are thoroughly grazed over, and in many localities the herds must be fed with hay, during part of the year at least. All of the water supply of the country which can be readily diverted is claimed or appropriated by irrigation or land companies, and almost without exception the irrigable lands along perennial streams has passed out of the hands of the Government. Still the demand for homes continues, and settlers are from necessity forced to attempt to make a living where conditions seem to be against them. There are thousands or perhaps millions of farms which can be purchased from individuals or corporations, but the possibilities of obtaining agricultural land from the Government seem to be almost exhausted.



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